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AN HOUR-GLASS STOMACH OBSERVED IN SITU.

By Thomas Dwight, M.D., LL.D.,

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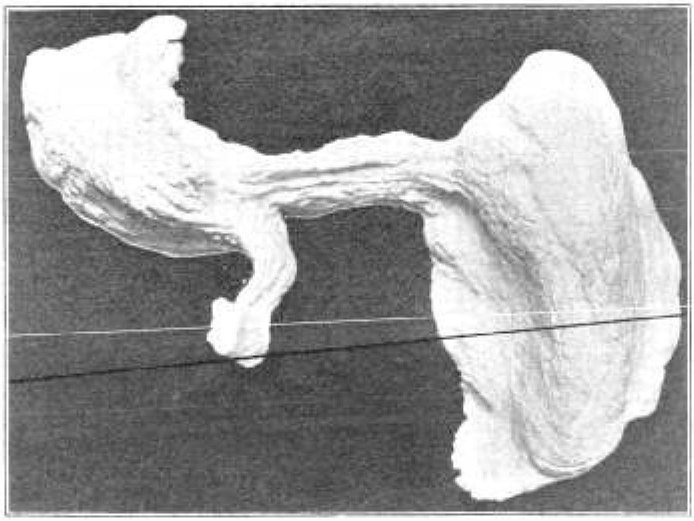
The examination of a series of frozen sections through the trunk of a male subject, which were made during the past winter, revealed a very remarkable hour-glass stomach. Perhaps the description of the organ may be of clinical value, for, so far as I know, this condition had never been observed *in situ;* that is, in a hardened body, as it must be if true ideas are to be gained of its shape and relations. Moreover, this specimen offers suggestions as to the etiology of the condition which if not new have at least been lost sight of, and calls attention to peculiarities of muscular action which at least are not generally recognized.

The body was that of a white man, aged sixty-six years, fairly well nourished. He died rather suddenly, probably of cerebral hemorrhage, about three months after his admission with a septic foot into a pauper institution. There is no record of any gastric symptoms. It appears from the frozen sections that the heart was dilated, especially on the right, and that the tricuspid valve was insufficient. The great veins near the heart were very much distended, but this may have been exaggerated by the venous injection.

The body was injected with a 10 per cent. solution of formalin and frozen. Sections were kept for a week or so in formalin before being transferred to alcohol. I would say, in passing, with regard to the technique, that could I command at pleasure a temperature of below zero (Fahrenheit), and were the sections once cleaned and mounted never to be touched again, I would have nothing to do with so disagreeable an agent as formalin; but it takes to a great extent the place of cold and adds much to the toughness of the slices, which is very useful if they are to be handled. Fig. 1 shows the general shape of the stomach, being from a photograph of a cast of the interior seen almost directly from above. Figs. 2 to 5 represent the upper surface of four successive slices. Fig. 6 is a view of the cast from the right and from behind. The cast is mounted as nearly as possible in the position it occupied in the body.

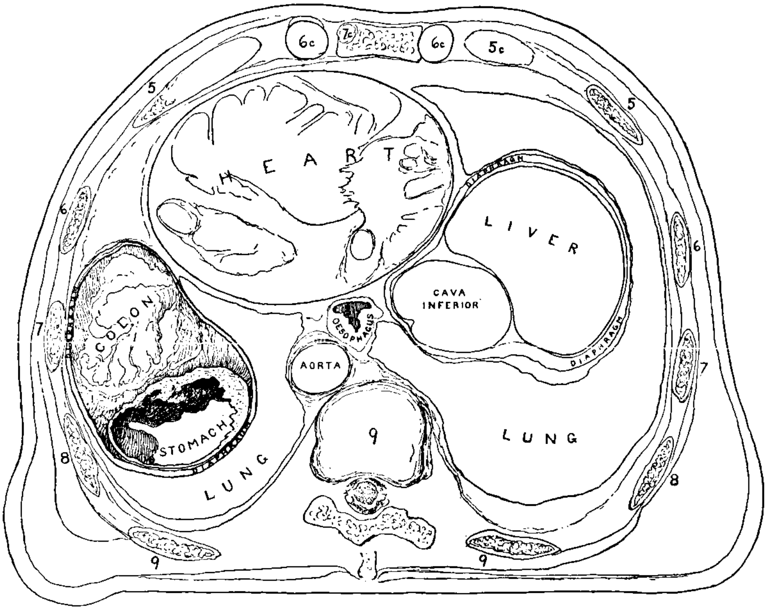
FIG. 1.



Cast of the inside of the stomach, seen almost directly from above. The anterior pouch is at the top; the posterior, with the œsophagus, is below. The black line indicates the median line of the body.

The œsophagus passes the diaphragm opposite the tenth thoracic vertebra in the thickness of the slice, the top of which is shown in Fig. 2, and is seen with the diaphragm still near it at the disk below the tenth vertebra in Fig. 3, running almost horizontally to the left and expanding, trumpet-like, into the stomach (Fig. 6). The mucous membrane does not show clearly the change from the œsophageal to the gastric kind; but this probably occurs nearly opposite the *star* in Fig. 3. The fundus then rises on the left and ends in the thickness of the slice above that shown in Fig. 2, near the top of the ninth thoracic vertebra and a little below the level of the left nipple, which in this body is opposite the fourth intercostal space. This upper division of the stomach (Fig. 2) is nearly oval on section, the anterior and posterior walls being nearer than the borders. Of these walls the former looks decidedly to the left and the latter to the right. The very summit of this division in the slice above that shown in Fig. 2 was, unfortunately, lost. Having no attachment to the part of the diaphragm just against it, there was nothing to restrain it, and it fell out of place and was overlooked. Happily there were means by which its shape could be approximately determined so as to justify its representation in the cast. The lowest part of the upper division extends downward to opposite the top of the twelfth thoracic vertebra, and then passes into the narrow passage connecting the two divisions. In Fig. 3 we see the upper surface of this narrow passage running forward, expanding and rising, so that in this section a part of each division is shown. The lumen of the constricted portion appears in Fig. 4. Its beginning is best shown in Fig. 3. It is a little behind a transverse vertical plane touching the front of the aorta. The posterior part of the apparent tube shown in Fig. 4 is somewhat behind this and therefore belongs to the first division. The position of the anterior end of the constriction is fairly well shown in Figs. 3 and 4. The measurements of the constricted portion are not very satisfactory, owing to the difficulty of choosing definite limits. The upper border measures about 7 cm. and the lower about 5 cm. The length of the left side may be called 7 cm. and that of the right only 4 cm. Its greatest diameter is from above downward. It is broadest below and would admit a forefinger easily. The very highest part of the inferior division is shown in Fig. 3, opposite the left sixth and seventh costal cartilages near the sternum. This division lies against the abdominal walls in the angle between the eighth costal cartilages, and narrows

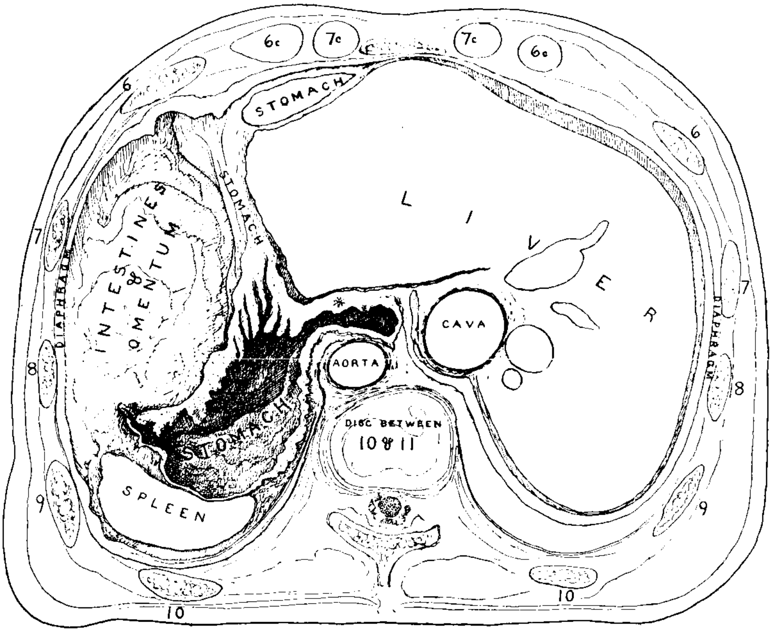
FIG. 2.



Section at the ninth thoracic vertebra through the upper part of the superior pouch.

gradually to the pylorus without any distinct *antrum pylori.* Fig. 5 shows a part of the pyloric thickening, but gives an erroneous impression of a tubular pyloric portion. The pylorus itself was constricted, but it could easily be dilated to permit the passage of an instrument nearly or quite 1 cm. in diameter. It is placed very far back, within less than one inch of the inferior cava, so that the pyloric portion usurps the place of the first part of the duodenum. The opening is opposite the lower part of the twelfth thoracic vertebra, a little above the plane of Fig. 5, and points directly backward. The general shade and position of the organ are best seen in Figs. 1 and 6. The former gives a good idea of the relative size of the component parts and of the relation of what might be called the long axis of the stomach to the median plane of the body. The latter shows the general direction of that axis in reference to a horizontal plane.

FIG. 3.

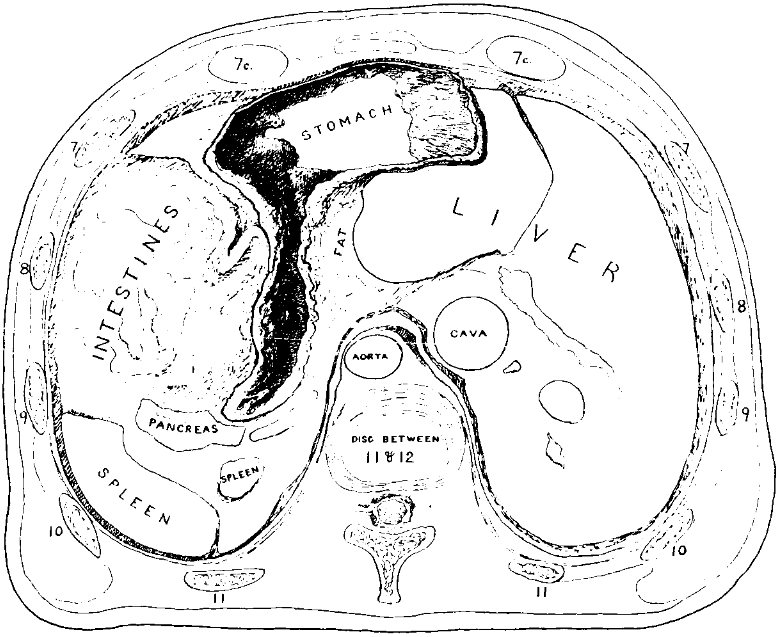


Section at disk between the tenth and eleventh thoracic vertebræ opening both pouches and passing above the tubular portion. The star indicates the passage of the œsophagus into the stomach.

We may sum up as follows: There are two sacs, of which the inferior is decidedly the larger, connected by a narrow tube. The œsophagus ends nearly horizontally in the superior pouch, which then ascends backward and to the left. The constriction begins at the level of the cardiac opening; it extends forward and somewhat downward, though its under side rises in the middle and empties into the lower or anterior pouch, the top of which is slightly above the level of the lowest part of the former. The course of the long axis of the stomach may be divided into three parts: The first is downward and somewhat forward, the second almost directly forward, and the third approximately horizontal and transverse. It is worthy of remark that the common axis as a whole might be said to be essentially from behind forward. We shall notice later Birmingham's views on this point.

As to the relations of the stomach, there is not much to say that could not be inferred. The line of the attachment of the great omentum to the stomach is very hard to follow. Apparently it passes behind the fundus in the slice shown in Fig. 2, runs along the left side of the constricted part, is continued along the lower border of the transverse part shown in Fig. 5, and ends at the right of the pylorus. The course of the lesser omentum is not to be made out. The great omentum, which covers the structures well named by Birmingham the stomach-bed, is not to be recognized. The relations of delicate membranes are not easily followed on frozen sections. The left crus of the diaphragm indents the posterior wall at about the end of the œsophagus. The spleen lies behind and external to the upper pouch. The compensatory relations of the colon with the stomach are well shown. The splenic

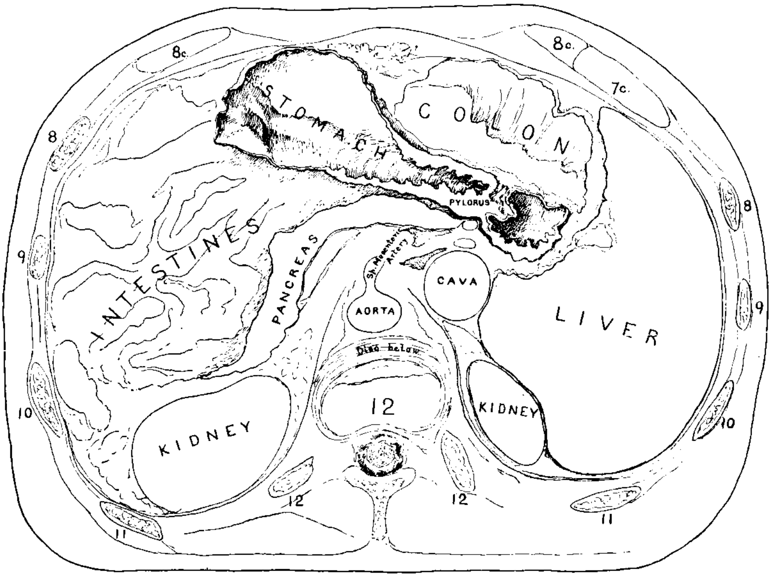
FIG. 4.



Section at disk between the eleventh and twelfth thoracic vertebræ through the lowest part of the superior pouch, the tubular portion, and the upper part of the inferior pouch.

flexure rises to the left of the upper pouch. A thick fold of mesentery (probably going to the jejunum) lies against the left of the constricted part, interposing between it and the transverse colon, which reappears beneath the lower pouch. As the latter narrows and passes obliquely backward to the pylorus, the transverse colon lies before it. The bend in the lower wall of the constricted portion is caused by the pancreas, over which it passes. The constricted portion above corresponds very closely to the border of the left lobe of the liver, which is between it and the heart. The second pouch is, of course, covered by the liver, the quadrate lobe covering the pyloric portion. The first portion of the duodenum is reduced to next to nothing, the gut descending immediately.

FIG. 5.

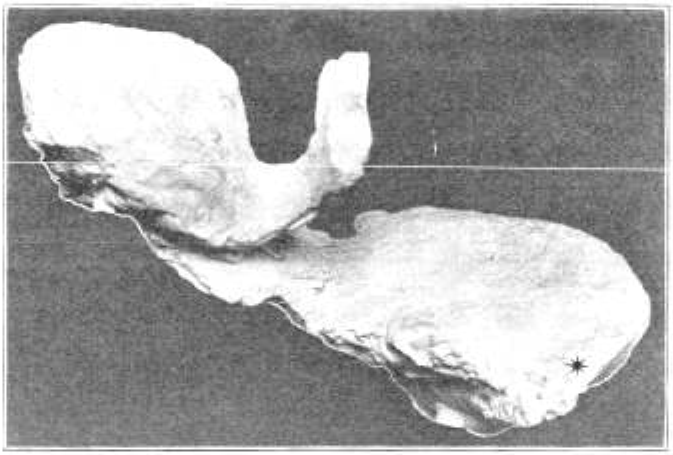


Section at the lower part of the twelfth thoracic vertebra, near the bottom of the inferior pouch and just below the pyloric opening.

We now come to the most interesting part with regard to the cause of this condition, namely, the walls of the stomach. The thickness of the walls varies very much. They are thinnest at the back of the first pouch, where the wall is probably less than 1 mm. through. The front part of this portion is much thicker than the rest (Fig. 2), and this thickness extends into the constricted portion, being greatest above and on the left. The lower and right sides are less markedly thickened, but they exceed the thickness of the dilated portions. Probably the thickest part of all is where the front of the upper pouch passes into the top and left of the tubular portion. The beginning of this part is thicker than its end. The thickening of the pyloric part, as shown in Fig. 5, is more apparent than real, owing to the section striking the wall obliquely near its upper part. There is, however, the usual ring at the pylorus.

The mucous membrane is very smooth throughout the lower pouch except for a series of folds in the last inch converging to the pylorus. The upper pouch presents many irregular folds. (It is to be remembered that the very summit, unfortunately, was lost.) The anterior wall of this pouch is covered by a network of folds, to which the cast fails to do justice. These increase in size as they reach the tubular portion, which presents a great abundance of large longitudinal folds, especially in the upper two-thirds of its cavity. They are most developed in the first part of the tube and make a great puckering into the upper pouch (Fig. 3). The highest folds, which are in the constricted portion, measure 1 cm. or more from base to summit. There are no traces of ulceration or of any disease in any part of the mucous membrane, but the great folds give the impression of the tubular part having been squeezed.

FIG. 6.



Cast of the inside of the stomach, seen obliquely from the right and behind. It shows approximately the inclination of the long axis of the stomach. The star marks the place of the pylorus.

The serous membrane covering the stomach presents in some places a very peculiar appearance. It seems to be filled with minute indentations, which on closer examination often resolve themselves into narrow, longitudinal depressed lines or creases. Sometimes both coexist, and the whole effect is sieve-like. I imagine that tissue like this has been described as cicatricial, but there is no justification for that term. The peritoneum follows the irregularities of the surface and is quite free from adhesions or other signs of inflammation. This appearance is limited pretty closely to the regions in which the walls are thickened and the folds of mucous membrane exuberant. It descends along the front of the upper pouch onto the top of the first half of the tubular part. It encroaches but very slightly on the second pouch, being found to a small extent on the left of the region shown in Fig. 4, just at its beginning. This portion, however, is insignificant.

Dr. George B. Magrath, of the Harvard Pathological Department, was kind enough to examine microscopically a piece taken from the front wall of the upper pouch a little above the tube, which combined thickness of the wall, redundancy of the folds, and the peculiar appearance of the outer surface. Of course, such a specimen was ill-suited to microscopic examination, as the stomach must have been far from fresh before any hardening agents were used. Dr. Magrath accordingly reported that the mucous membrane showed great post-mortem changes, that glands were to be recognized only here and there, but that the connective tissue between these glands was somewhat hyperplastic, containing more than the ordinary number of cells. The submucosa contained considerable fat tissue, but showed nothing pathological. There was some hypertrophy of the muscular tissue, especially (perhaps solely) of the outer layer, the enlarged aggregations of which gave the surface of the specimen its honeycombed appearance. In a few places there was more connective tissue than is normal between the muscular layers. The serosa showed no signs of thickening in the few places in which it was apparent. I am not aware that a similar microscopic observation has been made on an hour-glass stomach. In spite of its shortcomings, from the nature of the specimen, it is valuable as showing, in addition to an hypertrophy of the muscular tissue, a tendency to hyperplasia by which greater stability is given to the walls.

Among the reasons for which this specimen is valuable may be mentioned the light it throws on the position of the stomach. It is now recognized that the lesser curvature of the stomach is essentially vertical and not transverse; but what is not generally recognized is that the stomach has a very strong forward inclination, and that when empty this may be so great as to make the main axis almost horizontal from behind forward. This is well stated by Professor Birmingham in Cunningham's *Text-book of Anatomy*. He emphasizes also the very important fact that during life hollow organs with muscular walls are not flaccid when empty, but more or less contracted. I have reconstructed another stomach from frozen sections which, without being an hour-glass, was of a shape that would be utterly incomprehensible to one whose ideas were formed by the older descriptions. It was of small capacity, having been, presumably, nearly empty. It lay nearly horizontally. While the whole organ was in a more or less contracted state, the fundus was puckered up into a separate pouch. Birmingham's dissections of the muscles of the stomach show that there is a whorl over the fundus, which he derives from the innermost layer. My own dissections have inclined me to believe that it is made essentially by the middle or circular layer. As there is more or less intermingling of the layers, it is of little importance which of them predominates; but the contraction of the circular fibres at the periphery of the whorl would account for the puckering of the fundus into a pouch, which is to be observed also in this specimen.

Doubtless there are many causes of hour-glass stomach; in other words, all cases are not of the same nature. We are told that it may be congenital; but, so far as I am aware, there is only one case of a bilocular stomach on record in a fœtus or young child—that of Sandifort[1] in a fœtus. Dr. F. S. Watson,[2] in his excellent paper, classes many as congenital without, as it seems, sufficient grounds. Thus he subdivides all cases into congenital and acquired, the former being marked by the symmetry of the constriction and the absence of pathological processes connected with it. He considers this latter the only positive evidence of its congenital nature. He believes that the acquired cases are generally due to cicatrices from ulcers, or to fresh ulcers, or to adhesions to other organs, etc. He disregards the contractions that occur in the course of digestion. Excellent work has comparatively recently been done on the movements of the gastric walls during digestion by Dr. W. G. Cannon[3] and others, but it is interesting that the occurrence of rings of contraction was known to Sir Everard Home[4] nearly one hundred years ago. He speaks of finding bands in empty stomachs and not always in the same place. Thus they may be at the middle or nearer the pylorus. He insists on the necessity of making the examination soon after death. He made similar observations on animals with simple stomachs. Struthers[5] and others have since alluded to them. Such constrictions can be broken down by more or less pressure of injected air or fluid. Allusion has been made to a constriction becoming fixed or chronic, and this seems to me precisely what has occurred in this instance. The most remarkable feature of this stomach is the length of the narrow part. I am not clear that such another has been described. According to Dr. Watson's classification, this must be called congenital; but I do not so consider it. A contraction has somehow become chronic and then consolidated. There is no apparent disease of the mucous membrane, and certainly no inflammation or adhesion of the surface. How this happens I am not prepared to say. No one who has seen the specimen would for a moment admit that any amount of insufflation would overcome the constriction. The fact that it can be overcome in certain cases, but only with considerable difficulty, seems to indicate that there is an intermediate condition between an ordinary transitory contraction and consolidation. There are at least two other places where similar phenomena are observed; one, in fact, is in the same organ. I refer to the occasional appearance of the pyloric portion as a tube with very thick walls. I have observed this also in a series of frozen sections. The appearance of an inch or more of the stomach was that of a piece of small intestine, only with far thicker walls. It was not conceivable that it depended on any transitory contraction of the muscle. It seemed precisely as fixed as in this case. The other region is that of the descending colon, which is sometimes found contracted into a very small tube presenting a series of swellings. This condition may be found associated with irritation of the bowels and also when everything is apparently normal. It is presumably in many cases nothing but the normal contraction of an empty organ with muscular walls; on the other hand, it is sometimes so firm that it is hard to believe it is not permanent. It is further to be said in support of this view that this case was not congenital, but the result of muscular contraction; that in the former hypothesis one would not expect to see the great folds of mucous membrane in the constricted portion, which declare eloquently the effect of constriction.

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[1] Obs. Anat. Path., Tome iii. p. 11.

[2] Annals of Surgery, 1900, vol. xxxii.

[3] American Journal of Physiology, 1898, vol. i.

[4] Observations on the Stomachs of Different Animals, etc., Phil. Trans. for the year 1807, vol. xcvii. p. 139.

[5] Monthly Journal of Medical Science, Edinburgh, 1851, vol. i. p. 121.

It has been shown that in digestion waves of constriction pass along the stomach, and are most definite near the pylorus, where, when they become fixed, they no doubt make the single, the double, or even the triple *antrum pylori*, the last of which was mentioned long ago by Retzius.[1] I have seen reason to believe that not rarely there is a slight indication of a narrowing at the middle of the stomach. While it cannot be doubted that hour-glass stomach may be due to ulceration and cicatrices, it is not at all clear how these under ordinary circumstances can cause a circular constriction unless, as is most probable, the irritation produces a contraction of the circular fibres, which become set. Until we see more cases of hour-glass stomach at about the time of birth it is impossible to admit that it is congenital except very rarely. There is no convenient way of accounting for it as a reversion. Indeed, it is much more scientific to ascribe its origin to a phenomenon of contraction natural to a hollow muscular organ in any animal than to have recourse to the doctrine that the exceptional occurrence of some peculiar condition in man is *explained* by its being normal in the black bear or the white whale.[1]

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[1] Müller's Archiv, 1857.

AN OPERATION FOR THE REPAIR OF THE PELVIC FLOOR.

By J. G. Mumford, M.D.,
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At the present time it seems as though this subject, the cure of ruptured perineum, had been exhausted, because numberless surgeons have devised numberless operations for the repair of the lesion. My object in presenting this communication is to demonstrate an operation simple and effective and applicable to conditions from the most trifling to the most severe.

Long ago Mr. Tait performed an operation by which he succeeded in closing the vaginal outlet without any sacrifice of tissue; but his operation was very limited in scope and was ineffective as a repair of the pelvic floor. Taking Tait's operation as a point of departure I have elaborated a procedure which I have found useful and satisfactory in all routine cases, not only for the repair of the torn perineum, but also for the relief of cystocele and rectocele.

It seems hardly necessary to refer in detail to the anatomy of the region involved, but a few words of explanation are necessary.

The first muscle to be considered is the constrictor vaginæ, which with the sphincter ani goes to make up the rather delicate encircling portion concerned in these lacerations; closely associated with these muscles are the transverse perineal muscles with their attachments to the tuberosities of the ischia. The true pelvic floor, however, is the levator ani, and when this is extensively damaged the most serious displacements follow.

It is obvious that a laceration of these muscular structures not only destroys the inferior supports of the uterus, but of the bladder and rectum as well; especially when the mucous membrane of the vagina is much involved. The prolapse of the bladder and rectum has been

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[1] Dr. Bettmann gives a very good bibliography in his prize essay, The Shape and Position of the Stomach, Phil. Monthly Med. Journ., March, 1899. Dr. Watson reproduces in his paper the part relating to hour-glass stomach. I beg leave to point out one inaccuracy and to supply one omission. In the reference to Home's paper the pages are given as 170, 171. The reference on those pages is in an abstract of the papers published in the Transactions. The proper reference is as I have given it. On account of the little-known publication in which it appeared a very excellent paper by Prof. B. C. A. Windle on Sacculation of the Stomach has been overlooked. It is in Proc. Philosoph. Soc. of Birmingham, vol. vi.